REMARKS/ARGUMENTS

Claims 4, 8, 10, 13, 16, 22, 26, 28, 34, 38, 40, 43, 46, 52, 65-69, and 72 are amended, claims 9, 27, and 57 are canceled, and claims 75-76 are added herein. Claims 1-3, 19-21, 31-33, 49-51, and 61-64 have previously been canceled. With entry of this amendment, claims 4-8, 10-18, 22-26, 28-30, 34-48, 52-56, 58-60, and 65-76 will be pending.

As requested by the Examiner, the claims have been amended to provide reference to a path of the MPLS Traffic Engineering LSP between the head-end node and the tail-end node. More specifically, the claims have been amended to clarify that "wherein said virtual shortest path tree is used to compute a path of said MPLS Traffic Engineering LSP between said head-end node and said tail-end node."

As described in the specification, LSP refers to the paths taken by packets that traverse the network. MPLS Traffic Engineering establishes LSPs that have guaranteed bandwidth under certain conditions. Thus, MPLS Traffic Engineering is used to build guaranteed bandwidth end-to-end tunnels (i.e., head-end to tail-end) through an IP/MPLS network of label switched routers. These tunnels are a type of LSP and generally referred to by those skilled in the art as MPLS Traffic Engineering LSPs. MPLS Traffic Engineering and a path of the MPLS Traffic Engineering are both described in detail in the specification. For example, the Background of the Invention describes how MPLS Traffic Engineering exploits modern label switching techniques to build guaranteed bandwidth end-to-end tunnels through an IP/MPLS network of label switched routers. These tunnels are a type of label switched path (LSP) and thus are generally referred to as MPLS Traffic Engineering LSPs (see, page line, lines 7-12 of the specification). The Background further describes how establishment of an MPLS Traffic Engineering LSP from an LSP head-end to an LSP tail-end involves computation of a path through the network of LSRs and it is desirable to extend MPLS Traffic Engineering LSPs across AS boundaries. The specification further describes in detail how to compute a path of an MPLS Traffic Engineering LSP through Autonomous Systems and areas. Establishing an LSP requires computation of a path, signaling along the path, and modification of forwarding tables along the path. Fig. 2, for example, describes steps of computing a path of an MPLS Traffic

Engineering LSP across multiple Autonomous Systems in accordance with one embodiment. It is therefore submitted that use of the phrase "MPLS Traffic Engineering LSP" or "path of said MPLS Traffic Engineering LSP" is clearly defined by the specification and corresponding drawings.

In an effort to assist the Examiner in following the claim language, the following provides a description of the invention with reference to claim 4 and the specification.

Claim 4 is directed to a method for operating a first path computation element in a first autonomous system to participate in establishing an inter-autonomous system MPLS Traffic Engineering LSP between a head-end node and a tail-end node. Fig. 1 illustrates an example of three Autonomous Systems (AS1, AS2, AS3) with a head-end node 102 and a tail-end node 104.

A path computation element is an entity having the capability to compute paths between any nodes in an AS and communicate with other path computation elements in other Autonomous Systems. Each AS has a dedicated path computation element. Thus, a path computation element may be located in the same AS as the head-end node, the same AS as the tail-end node, or a different AS.

The first path computation element of claim 4 receives virtual shortest path tree information from a second path computation element located in a second autonomous system. The virtual shortest path tree information identifies a virtual shortest path tree rooted at the tail-end node and extending to one or more border routers linking the first autonomous system and the second autonomous system. As described in detail in the specification, at successive recursive states, a VSPTi is developed by PCEi and then transferred to PCEi-1. The VSPTi is rooted at the MPLS Traffic Engineering LSP destination (tail-end node) and extends to the entry border routers that interconnect each AS. For example, referring to Fig. 1, ASBR9 computes a virtual shortest path tree rooted at the tail-end node 104 (referred to as VSPT3) (see, Fig. 3A). VSPT3 is sent to ASBR8 which concatenates the topology of AS2 with VSPT3 resulting in a revised VSPT (VSP2 shown in Fig. 3C). Information specifying VSPT2 is sent to ASBR1, which concatenates the topology of AS1 with VSPT2 to obtain a mesh shown in Fig. 3D, used to find a shortest path. One or more of the shortest paths are reported to the head-end node 102.

The VSPTs are thus used to compute a path of the MPLS Traffic Engineering LSP between the head-end node and the tail-end node.

The first path computation element of claim 4 may be located at any AS along the path between the head-end node and the tail-end node. Claim 4 specifies that the virtual shortest path tree is rooted at the tail-end node and extends to one or more border routers linking the first autonomous system and the second autonomous system (containing the second path computation element). In the example shown in Fig. 1, the first path computation element may be, for example, ASBR8 in AS2. The first path computation element receives virtual shortest path tree information (e.g., VSPT3) from a second path computation element (e.g., ASBR9 in AS3 of Fig. 1). The revised VSPT (e.g., VSPT2) extends from the tail-end node 104 to one or more border routers linking the first and third autonomous systems (e.g., border router ASBR4 in AS2 of Fig. 1). The first path computation element sends information identifying the revised virtual shortest path tree (VSPT2) to a third path computation element in the third autonomous system (e.g., ASBR1 in AS1 of Fig. 1). The revised VSPT is used to compute a path of the MPLS Traffic Engineering LSP between the head-end node and the tail end node. In the example of Fig. 1, the revised VSPT (VSP2) is sent to a path computation element (ASBR1) located in the same AS as the head-end node. ASBR1 concatenates the topology of AS1 with VSP2 to obtain a mesh shown in Fig. 3D. ASBR1 can then find a shortest path for use as the MPLS Traffic Engineering LSP between the head-end node and the tail-end node.

In the example shown in Fig. 1, AS3 is connected to AS2, which is connected to AS1. The inter-autonomous system may include any number of connected autonomous systems. Each autonomous system may be connected to only one other autonomous system or more than one autonomous system. The claims set forth establishing an inter-autonomous system MPLS Traffic Engineering LSP between a head-end node and a tail-end node. The path thus extends between the head-end node and the tail-end node and through the connected autonomous systems. The Examiner notes that with regard to claim 4, the second and third autonomous systems may not be connected. Applicant agrees. As described above with respect to claim 4, AS 1 is connected to both AS2 and AS3. There is no reason that AS2 needs to be connected directly to AS3. The path of the inter-autonomous system extends from a head-end node in one autonomous system to a tail-end node in another autonomous systems and any number of

autonomous systems may be located between these two autonomous systems to form the inter-autonomous system.

Accordingly, claim 4 is believed to comply with the requirements of 35 U.S.C. 112.

Independent claims 22, 34, 52, 65, 67, and 69 are also submitted to comply with the requirements of 35 U.S.C. 112 for the reasons discussed above with respect to claim 4.

Claim 8 is directed to a method of operation a first path computation element in a first autonomous system to participate in establishing a MPLS Traffic Engineering LSP from a head-end node in a first autonomous system to a tail-end node in a second autonomous system. The method includes receiving at the first path computation element, a path computation request from the head-end node. With reference to the example of Fig. 1, the first path computation element may be ASBR1 in AS1. The first path computation element transmits the request to a second path computation element in a third AS bordering the first AS (e.g., ASBR4 in AS2 in Fig. 1). The first path computation element then receives VSPT information from the second path computation element. The VSPT information identifies a VSPT rooted at the tail-end node (e.g., tail-end node 104 in AS3 in Fig. 1) and extending to one or more border routers connected in both the first AS and the third AS (e.g., ASBR4 in AS2 in Fig. 1).

The Examiner notes in claim 8 that the second and third autonomous systems may not be connected. The claim specifies that the virtual shortest path tree extends from the tail-end node in the second autonomous system to one or more border routers connected in both the first and third autonomous systems. Thus, there is a path extending from the second autonomous system to the third autonomous system. The second and third autonomous systems may be directly connected or there may be one or more intervening autonomous systems connecting the two autonomous systems.

Accordingly, claim 8 is believed to comply with the requirements of 35 U.S.C. 112.

Independent claims 26, 38, 56, 66, 68, and 72 are also submitted to comply with the requirements of 35 U.S.C. 112 for the reasons discussed above with respect to claim 8.

Claim 13 is directed to a method for operating a first path computation element in a first area to participate in establishing a MPLS Traffic Engineering LSP from a head-end node in the first area to a tail-end node in a second area. With reference to Fig. 1, the first path computation element may be, for example, ASBR1 in AS1 with head-end node 102. The method includes computing at the first path computation element a VSPT rooted at the head-end node and extending to one or more border routers connected to the first area and a third area (e.g., ASBR1, ASBR2, ASBR3 in AS1 in Fig. 1). The first path computation element sends information identifying the VSPT to a second path computation element operating on a border router connected in both the third area and the second area (e.g., ASBR8 in AS2 in Fig. 1). Since a border connects both the third and second area, these areas are connected.

Accordingly, claim 13 is believed to comply with the requirements of 35 U.S.C. 112.

Independent claim 43 is also submitted to comply with the requirements of 35 U.S.C. 112 for the reasons discussed above with respect to claim 13.

Claim 16 is directed to a method for operating a first path computation element connected in a first area and a second area to participate in establishing a MPLS TE LSP from a head-end node in a third area to a tail-end node in the first area. Referring to the example of Fig. 1, the first path computation element may be ASBR8 in AS2, for example. The method includes receiving at the first path computation element, information identifying a VSPT rooted at the head-end node and extending to one or more border routers connected in both the third area and the second area (e.g., ASBR1, ASBR2, ASBR3). The first path computation element performs computations to extend the VSPT through the second area and the third area (e.g., through AS1 and AS2 in Fig. 1). The first path computation element identifies a path for the MPLS TE LSP based on the extending VSPT. As previously described, the computed path is a path of the MPLS TE LSP. Thus, the body of the claim clearly sets forth operating a path computation element to participate in establishing a MPLS TE LSP from a head-end node to a tail-end node, as set forth in the preamble.

Accordingly, claim 16 is believed to comply with the requirements of 35 U.S.C. 112.

Independent claim 46 is also submitted to comply with the requirements of 35 U.S.C. 112 for the reasons discussed above with respect to claim 16.

As described in detail above, the claims have been amended to overcome the pending rejections under 35 U.S.C. 112. Therefore, based on the Allowable Subject Matter specified by the Examiner, all claims are believed to be in proper form for allowance.

For the foregoing reasons, Applicants believe that all of the pending claims are in condition for allowance and should be passed to issue. If the Examiner feels that a telephone conference would in any way expedite the prosecution of the application, please do not hesitate to call the undersigned at (408) 399-5608.

Respectfully submitted,

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